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ABSTRACT

The guide lists program objectives for science instruction of hearing impaired students at Kendall Demonstration Elementary School. The curriculum, it is explained, is based on theories of J. Piaget. Objectives are stated in terms of process skills within four Piagetian stages of development: pre-operational, transition to concrete, concrete, and transition to formal. Process terms used in the behavioral objectives are defined (observation, classification, communication, measurement, investigation, prediction, and formulation and testing of hypotheses). Science content of the objectives addresses three major categories (sample subcategories in parentheses): physical science (properties of matter, energy, force, work, and motion); earth science (geology, climatology and oceanography, and astronomy); and biological science (growth and reproduction, habit, structure, human application, and human reproduction). An explanation of student placement within the curriculum and a brief listing of sources of material are also provided. Comments from the curriculum evaluation are summarized in terms of scholarship, usefulness, equity, communicability, and appeal. (CL)

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Program Objectives for Science

ED225326

Kendall Demonstration Elementary School
Gallaudet College

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INTRODUCTION

PROGRAM OBJECTIVES FOR SCIENCE

Intended Users

These objectives are intended for use in elementary schools by classroom teachers. It would be helpful for teachers to have a background in science content and teaching methods. It is also advisable that the teacher have some familiarity with the learning theory of Jean Piaget. This may be acquired by reading a book such as Piaget for Teachers by Hans Furth (Prentice Hall, 1970) or Piaget for Educators by Robert B. Sund (Charles E. Merrill, 1976).

Goals

The science program has four primary goals:

1) To provide all students with experiences through which they are led toward the development of rational (formal) thought processes. Scientific methods are the basis on which experiences are structured. Scientific knowledge is the content of the experiences provided.

2) To develop, in all students, adequate survival skills.

3) To provide all students with an experience-based instructional model (exploration, concept introduction, concept application).

4) To encourage, in all students, the development of more positive attitudes, interests, and values toward science.

Approach

This program employs the process approach to the study of science. The students engage in such scientific processes as observation, classification, prediction, and formulation of hypotheses. Within the structure of the process approach the student learns science content, but it is believed that the approach is of far more importance than the content covered.

The program is set forth in behaviorally stated objectives. Fulfillment of the objectives requires active participation by the student in the scientific process.

DEVELOPMENTAL SEQUENCE

Jean Piaget suggests that there are identifiable stages or levels in the development of a child's intelligence. One of his major tenets is that tasks set for children to perform should be appropriate to their developmental levels. The objectives of this program have been written and sequenced in accordance with Piaget's levels of development. (Piaget emphasizes that a child's age is not a totally accurate indication of its level of development.)

The four stages of Piaget that are used in the science objectives are pre-operational, transition to concrete, concrete, and transition to formal. A short description of each of these stages follows.

PRE-OPERATIONAL (PO): The student is bound by his/her perceptions--especially visual. The child has formed simple underlying concepts, but these are not well defined enough to override perceptual input. Learning occurs via seeing and manipulating, not by verbal representation.

TRANSITION TO CONCRETE (TC): The student begins to use logical thought processes to override perceptual input, especially in areas in which the student has experience. The student fluctuates between the pre-operational and concrete levels, often during a single experience.

CONCRETE (C): The student uses logical thought processes if perceptual (especially visual) stimuli are present. However, the child is still unable to apply logical thinking to "words only" situations.

TRANSITION TO FORMAL (TF): The student is beginning to be able to use logical propositions and hypothetical reasoning without the necessity of having concrete objects to support thought processes. The student fluctuates between the concrete and the formal levels. Because of this fluctuation, hypothesis formation should be supported by the presence of concrete instances and objects.

The objectives within each Piagetian level are stated in terms of the process skills which a student on that level should be able to do. These process skills and their appropriateness at a particular level are shown in Figure 1. The teacher is encouraged to write additional appropriate sub-objectives in the space provided after each objective.

PROCESS TERMS

As noted previously, the objectives are behavioral and are stated as process skills. These skills are those appropriate at each developmental level. The sub-objectives, which include appropriate process skills, are a listing of possible activities to achieve the main objective. It is not necessary for a student to complete every sub-objective. In addition, there is space provided for the teacher to add other sub-objectives.

The process skills used in the objectives are explained below. Active participation of the student is an essential factor in completing these objectives.

Observation: The student must use each of the five senses when coming in contact with objects or organisms. The information which the student observes from the environment is then communicated in some way to others in the class situation.

Classification: At the lower levels, the student actually places objects or pictures of objects in groups. At the higher levels the students could use pictures or vocabulary for pictures or objects. These then would be grouped. Communication is also a part of this skill. The students should be asked to explain their classification schemes.

Communication (Recording): Each process skill includes through the air communication of ideas. However, this process calls for a written record of observations, classifications, or other processes. The student should write down information in a specified format, such as table, chart, or graph.

Measurement: In order to do accurate measurement a student must be able to use measuring instruments properly, and carry out calculations with the measurements. It also requires that the student choose the appropriate measurement tool. With measurement in the "Transition to Concrete" level, the student should not be asked to use exact measurement skills with standard measurement tools. These skills should be required only at the higher levels.

Investigation: This process, used in the higher levels, focuses on experimentation. The students are presented with a problem. They try to find a possible solution or explanation through experimentation. Developing an experiment involves accurate observation and precise communication and recording of data. Developing an experiment could also include accurate predictions of outcomes.

Prediction: The student should, when presented with an experiment, give a reasonable statement as to its result. This skill should be refined as more experiments are completed. Prediction can also include estimation skills in measurement.

Formulating and Testing Hypotheses: An hypothesis is a general statement explaining an event, including observed and unobserved phenomena. This statement is then used as the basis for further experimentation. The student would have to discuss events and develop a statement of fact about these events. That statement would be tested, when the student developed appropriate experimentation. The student is thus required to develop a statement to explain an event, test that statement, and prove or disprove the statement.

Figure 1
Process Skills Used at Four Piagetian Levels of Thought

Process Skill	Piagetian Level of Thought			
	PO	TC	C	TF
Observation	X	X	X	X
Classification	X	X	X	X
Communication (Recording)		X	X	X
Measurement		X	X	X
Investigation			X	X
Prediction			X	X
Formulation of hypotheses				X
Testing of hypotheses				X

SCIENCE CONTENT

The content information in the program is divided into three major content categories and a number of content subcategories. These are listed below:

	Category Code
Physical Science	
Properties of Matter	PM
Energy	E
Force, Work, and Motion (space/time)	F
Earth Science	
Geology	G
Climatology and Oceanography	CO
Astronomy	A

Biological Science

Growth and Reproduction	GR
Habitat	H
Structure	S
Human Application	HA
Human Reproduction	HR

Each objective is labeled with a category code and a number. For example, objective G3 is a geology objective.

Organization of Objectives

The science objectives are stated in terms of behavioral objectives, which are organized along the above described three dimensions: the stages of a child's intellectual development (according to Piaget); the scientific content; and the processes of science. For example, objective F3, "Observe characteristics of objects in motion," is placed at the Piagetian pre-operational level, deals with the concept of motion, and requires the scientific process of observation.

The Piagetian levels form the four major categories. Within each of these categories, the objectives are arranged by the content (physical science, earth science, biological science). The objectives themselves specify the scientific process (observe, classify, etc.).

Placement of Students

Students should be placed in the program according to their developmental level and go forward from there. Generally, a student should complete all the objectives on a developmental level before proceeding to the next level.

To determine the level of each student, Piagetian tests can be administered in either group or individual testing. Such items as seriation, conservation of number, conservation of weight, bottle rotation, conservation of volume and ratio could be used.

Figure 2 shows the expected performance at each developmental level. A student on the pre-operational level would probably not pass any of the tests listed. A student on the transition to concrete level would pass some but not all of the beginning tasks. Because the tasks are listed according to level of difficulty, the student on a concrete level would pass most, if not all, of the first half of the tasks. Ratio, pendulums, and permutations are formal tasks. Therefore, a student on the transition to formal level would pass all of the concrete tasks including the most difficult (displacement of volume) and could pass some of the formal tasks.

The following books can be used as references for information on Piaget and also on administration and test items for the tasks listed:

Piaget for Teachers, Hans G. Furth, Prentice Hall, Inc., 1970.

Piaget for Educators, Robert B. Sund, Charles E. Merrill Publishing Co., 1976.

A record of each student's progress is kept by marking the student's achievement of each objective on his/her "network chart." The networks are explained on page 85 of this guide.

Figure 2
Piagetian Tests for Student Placement

	PO	TC	C	TF
Classification (2 groups)	-(+)	+	+	+
Seriation	-	+	+	+
Reversibility	-	-	+	+
Bottle Rotation	-	-	+	+
Conservation of:				
Number	-	+(-)	+	+
Length	-	+(-)	+	+
Weight	-	-	+(-)	+
Displacement of Weight	-	-	+(-)	+
Ratio	-	-	-	+(-)
Pendulums	-	-	-	+(-)
Permutations	-	-	-	+(-)

+ means pass
- means fail
+(-) means most students should pass, although some may not
-(+) means most students should not pass, although some may

Sources of Materials

Each page of the objectives has a section titled Sources. This section lists some of the materials available at Kendall Demonstration Elementary School for teaching the objectives. The materials and sources which are listed are only a small sample of science materials available on the topics. The teacher should add to this listing where appropriate.

Sources of Material

Modular Activities Program in Science (MAPS)*
Houghton Mifflin Company
Boston, MA

Elementary Science Study (ESS)
McGraw-Hill Book Company
New York, NY

Science--A Process Approach (SAPA)
American Association for the Advancement of Science
Order from:
Xerox Educational Publications
P. O. Box 16629
Columbus, OH 43216

Science Curriculum Improvement Study (SCIS)
University of California
Rand McNally and Co.
P. O. Box 7600
Chicago, IL 60680

Human Sexuality Curriculum
Pennsylvania School for the Deaf
7500 Germantown Avenue
Philadelphia, PA

Examining Your Environment (EYE)
Adam Stecher, et al. (1971)
Holt, Rinehart and Winston
New York, NY 10017

Elementary School Science (STEM)
Addison-Wesley Publishing Co.
Menlo Park, CA

* MAPS is in the process of being revised. The new edition will be called Science.

PROGRAM OBJECTIVES

Pre-operational: The student is bound by his/her perceptions, especially the visual. The student has formed simple underlying concepts, but these are not well enough defined to override perceptual input. Learning occurs via seeing and manipulating, not by verbal representation.

PM1 Observe properties of matter using each of the five senses.

Sources

Elementary School Science - Primer (STEM)

Modular Activities Program in Science - 1 (MAPS)

a. Observe and distinguish the primary and secondary colors.
b. Observe and distinguish sound and no sound.*
c. Observe and compare sounds.*
d. Observe and compare the sizes of objects (big, small, large, little).
e. Observe and compare shapes (circle, square, rectangle, triangle).
f. Observe and compare textures (hard, soft, rough, smooth, wet, dry).
g. Observe and compare tastes (bitter, salty, sweet, sour, like, dislike).
h. Observe and compare odors (strong, weak, like, dislike, pleasant, unpleasant).
i. Observe and compare the relative density of various objects in water (float, sink).
j. Observe and compare various solids (rectangular solid, sphere, cone, cube, cylinder, pyramid).
k. Observe and compare taste concentration (two distinguishable concentrations of salt water or sugar water).
l. Observe and compare odor concentrations (two distinguishable concentrations of vinegar water).

* Objectives on sound are also included in the section on energy.

_____PM2 Classify matter according to two properties for a specific characteristic.

a. Classify objects by color (red vs. blue).
b. Classify objects according to size (big vs. little).
c. Classify objects according to two-dimensional shape (circle vs. square).
d. Classify objects according to three-dimensional shape (sphere vs. cube).
e. Classify objects according to texture (soft vs. hard).
f. Classify objects according to taste (sweet vs. sour).
g. Classify objects according to smell (like vs. dislike).
h. Classify objects according to relative density (heavy vs. light, float vs. sink).
i. Classify odors by concentration (strong vs. weak).
j. Classify taste by concentration (more vs. less).
k. Classify sounds by loudness (loud vs. quiet).

Sources

Elementary Science Study (ESS)-(Sink or Float)

STEM - 2

MAPS - 2

Sources

STEM - Primer
STEM - 1

____ E1 Observe the presence or absence of different forms of energy (sound, heat, chemical, electrical, and mechanical).

a. Observe and compare on and off (lights, sound, water, machines).
b. Observe and compare hot and cold.
c. Observe and compare push and pull.
d. Observe sound and no sound.*
e. Observe and compare a candle before, during, and after burning.

____ E2 Identify the sense used to detect various energy forms.

a. Identify the sense(s) which detect light energy.
b. Identify the sense(s) which detect heat energy.
c. Identify the sense(s) which detect sound energy.
d. Identify the sense(s) which detect motion.
e. Identify the sense(s) which detect static electricity.

* Objectives on sound are also included in the section on properties of matter.

Sources

STEM-2

_____E3 Observe sources of various energy forms.

a. Observe and name sources of mechanical energy (cars, trucks, wind-up toys, simple machines).
b. Observe and name sources of electricity (lightning, batteries, static).
c. Observe and name sources of light (sun, fire, light bulb).
d. Observe and name sources of sound (radio, tape recorder, voice).
e. Observe and name sources of heat (sun, radiator, mammals).

_____E4 Classify in two groups observed characteristics for each appropriate energy form.

a. Classify as fast or slow (mechanical).
b. Classify as hot or cold (water).
c. Classify as loud or soft (sound, vibrations, oscilloscope).
d. Classify as light or dark, bright or dim (light).

Sources

_____ E5 Describe the proper use of energy types.

a. Describe safety procedures in relation to the use of each energy form.
b. Describe conservation measures in relation to the use of each energy form.

Sources

Science--A Process Approach (SAPA)-(Slips & Slides)

____F1 Observe the effects of pushing and pulling.

a. Experience pushes and pulls.
b. Experience magnets (attraction, repulsion).
c. Observe that objects fall down (pull of gravity).

____F2 Observe the effects of work in terms of its change on a system.

a. Experience work as easy or difficult.

____F3 Observe characteristics of objects in motion.

STEM - Primer
MAPS - 1

a. Observe relative position (near, far).
b. Observe paths of motion (curved, straight).
c. Observe varying speeds (fast, slow).
d. Observe the characteristics of moving objects.
e. Observe the characteristics of falling objects.
f. Observe the characteristics of spinning objects
g. Observe the characteristics of revolving objects.
h. Observe the characteristics of unwinding objects.

Sources

STEM-2

____F4 Observe and characterize force, work, and motion in everyday objects.

a. Classify movement of objects according to fast/slow, moving/not moving.
b. Classify the force of objects as heavy or light, strong or weak.
c. Classify work as easy or difficult.

Sources

_____G1 Examine rocks (mineral and non-mineral), dirt, sand, and mud.

Sand Box

a. Observe, name, and compare rocks and soil.

____G2 Observe, name, and compare types of landforms.

Sand box

a. Examine hills, rivers, fields, gulleys, and holes.
b. Construct simple landforms.

____G3 Observe and compare changes in the physical landscape.

a. Examine the effects of erosion.

____G4 Observe and compare common uses of rocks and minerals.

Sources

____C1 Observe, name, and record daily changes in weather.

STEM-1

a. Observe daily changes in weather (hot, cold, wet, dry, rain, snow, sun, clouds, wind).

____C2 Observe, name, and record changes in seasons.

a. Observe changes in seasons (summer, fall, winter, and spring).

Sources

____A1 Observe characteristics of the sky.

a. Observe and compare night, day, dark, and light.
b. Observe and compare sun, moon, earth, sky, and clouds.
c. Observe the sequence of morning, afternoon, and night.
d. Observe and compare sunrise, sunset, dusk, twilight, and dawn.
e. Observe and compare objects in the day and night skies.

____A2 Observe changes in the position of objects in the sky. ESS (Daytime Astronomy)

a. Observe and record positions of the sun, moon, and clouds.

____A3 Observe shadows of objects.

a. Experience shadow play indoors and outdoors.

Sources

_____GR1 Observe and name a variety of plants and animals.

_____GR2 Observe the germination and growth of plants, and the growth of animals. STEM-1

a. Observe seeds (find seeds in fruits and vegetables).
b. Observe plant seed germination and growth.
c. Observe animal growth.
d. Observe fully grown plants and animals in relation to size.

_____GR3 Observe changes in plants and animals. MAPS-2

a. Observe development during plant growth (flowers, leaves, seeds, fruits).
b. Observe and compare the seasonal differences in plants (trees lose leaves).
c. Observe and compare the seasonal effects on animals (color, hair growth, sleeping habits, feeding habits, movement, death rates).

Sources

_____H1 Observe critical life situations (birth, death, disease, thirst, feeding).

a. Observe a plant or animal when healthy or sick.
b. Observe cleanliness (washing hands, covering mouth, use of napkins, eating, bathing) as a means of preventing disease in humans.
c. Observe that seeds need light, soil, air, and water to germinate and grow.
d. Observe what animals need for growth and development (food, air, water, shelter).
e. Observe and compare where animals live (land, air, water).
f. Observe and compare the process of caring for and handling animals and plants.
g. Observe and compare animal homes, shelters.

Sources

____S1 Observe the structure of plants and animals.

a. Observe and compare structure of different plants (woody, herbaceous//flowers, fruits).
b. Observe and compare the structure of animals (legs, wings, shells, feathers, hair, symmetry).
c. Observe the structure of prehistoric life.
d. Observe and compare the structure of male and female.

Sources

MAPS-2

____HA1 Observe plants and animals that are eaten for food.

a. Observe plants that are eaten for food by humans (common fruits and vegetables).
b. Observe seeds that are eaten for food by humans.
c. Observe animals that are eaten for food by humans.
d. Observe a simple food chain (e.g., grass, rabbit, fox).

____HA2 Observe the proper handling of environmental materials to promote good health habits.

a. Observe good health habits (disposal of waste, clean work area, etc.).

Sources

Sex. Ed. Curriculum

_____HR1 Observe the reproductive organs of plants and the genitalia of animals.

a. Observe the stamens and pistils of flowers.
b. Observe and compare the penises and vaginas of vertebrates.

_____HR2 Observe and compare the major stages of human development (childhood, adolescence, adulthood).

Transition to Concrete: The student begins to use logical thought processes to override perceptual input, especially in areas in which the student has experience. The student fluctuates between the pre-operational and concrete levels, often during a single experience.

Sources

____PM3 Classify objects according to two specific properties for two major characteristics. — ESS (Sink or Float)

a. Classify solid objects according to two major characteristics, such as color and texture, or shape and size. Include characteristics such as textures (if applicable), color, size, shape, and density (float/sink, heavy/light).

____PM4 Observe different states of matter in everyday objects. — MAPS-2, MAPS-3

a. Observe and manipulate water in its three states.
b. Observe the physical properties of solids, liquids, and gases.

_____PM5 Observe changes in matter.

Sources

MAPS-3
Vinegar and baking soda
STEM-2

a. Observe physical changes in matter (steam condensed to liquid; salt crystal formed from evaporated water).
b. Observe chemical changes in matter (burning of wood, souring of milk, rusting of iron).

Sources

STEM-4

____E6 Identify sources of energy (by type) for objects in everyday living (sound, light, heat, mechanical, electrical, chemical).

a. Identify sources of electricity (batteries, rubbing, solar cell, hand generator).
b. Identify sources of heat (stove, sun, fire, friction).
c. Identify objects that make sound (radio, cars, trucks).
d. Identify both pleasant and unpleasant sounds in the environment (trucks, music).
e. Identify objects that use mechanical energy (windup toys, simple machines).
f. Identify sources of chemical energy (mix vinegar and baking soda).
g. Identify more sources of light (flashlight, moon, star).

____E7 Classify according to energy users and producers.*

a. Identify objects, appliances, and equipment that use different types of energy.
b. Identify objects, appliances, and equipment that seem to produce energy.

* Note: A producer is actually a changer of energy.

Sources

_____E8 Demonstrate a simple system which produces each type of energy.

a. Experiment with the production of different energy forms.

ESS (Mobiles)
ESS (Batteries & Bulbs)

_____E9 Observe and compare instruments that measure energy (thermometer, electric meter).

_____E10 Classify, in a qualitative, manner, the characteristics of energy types.

a. Classify temperature (hot, warm, cold).
b. Classify hues and shades of color (light, bright, dark, dull, shiny, gray, etc.).
c. Classify high and low sounds (sound, vibration, oscilloscope).
d. Classify the effects of electricity.

ESS (Primary Balancing)
tuning forks
fire
musical instruments
STEM-3

Sources

_____E11 Measure in a qualitative manner the relative degree of energy present in a system. STEM-3

a. Classify substances by temperature (hot, cold, warm, cool).

_____E12 Observe how different energy forms are transmitted and contained. STEM-4 MAPS-4

a. Observe conductors and insulators of electricity.
b. Observe conductors and insulators of heat.
c. Observe various opaque, translucent, and transparent materials which conduct and absorb light.
d. Observe objects that reflect light and images (metal, flat mirror).
e. Observe the effect of convex and concave lenses and mirrors.
f. Observe conductors and insulators of sound.

Sources

F13 Demonstrate the proper care in the use of energy forms.

a. Demonstrate safety procedures in laboratory activities and home practices.
b. Demonstrate conservation procedures in school and home practice.

Sources

ESS (Primary Balancing)
STEM-3
MAPS-3
MAPS-4

____F5 Classify forces which push and pull.

a. Classify magnets (rod, horseshoe, bar, U, natural).

____F6 Observe forces and describe their effects on objects.

a. Observe and describe simple machines (lever, wheel and axle, inclined plane).

____F7 Define work in a qualitative or operational sense.

(Work is defined as movement of an object over a distance; e.g., boy pushes a toy car across a table.)

Sources

____F8 Observe change within a variety of systems. MAPS-4

a. Describe an object's ability to do work.
b. Classify situations according to work/no work performed.
c. Observe work in terms of changes within a system.

____F9 Classify characteristics of objects in motion (distance over time). STEM-4

a. Describe the characteristics of objects in motion.
b. Classify objects according to their relative distance (near, far).
c. Classify change according to relative times (long time/short time).
d. Classify characteristics of motion (up, down, etc.).

____F10 Classify characteristics of machines in everyday living.

a. Classify according to machine/non-machine (commonly used machines).
b. Classify situations according to simple machine used (lever, wheel, inclined plane).
c. Observe other uses of simple machines (screw, wedge, pulley).

Sources

____ G5 Observe and distinguish between layers of soil.

MAPS-4

____ G6 Classify rock and soil types.

ESS - (Rocks and Charts)

a. Classify rocks, soils, and minerals according to color, luster, size, relative weight (density), and texture.
b. Classify rocks, dirt, sand, and mud.

____ G7 Classify types of landforms.

Instant papier mache
Sand box
Clay

a. Classify common landforms (mountain, valley, swamp, volcano, cave).
b. Construct common landforms.

Sources

____G8 Identify and demonstrate changes in the environment.

a. Distinguish between methods for geological change (earthquake, volcano, flood).
b. Demonstrate how rocks are broken down into soil.
c. Discuss the effects of wind, water, heat, and people on soil.
d. Discuss the ongoing process of erosion and its effects on the earth.

____G9 Classify uses of rocks and minerals.

a. Classify rocks and minerals as building materials.
b. Classify rocks and minerals as sources of energy.
c. Classify rocks and minerals as sources of metals.

Sources

Examining your Environment (Mini-climates) STEM-4

____C3 Observe, record, and classify changes in weather over a short period of time (one week).

a. Observe wind as moving air.
b. Observe and record relative rainfall, temperature, and the presence or absence of wind.
c. Observe and name the major cloud formations (cumulus, nimbus, stratus, cirrus).
d. Record and classify weather conditions (fog, mist, sprinkle, drizzle, shower, thunder, lightning, dew, frost, snow).

____C4 Observe, record, and compare changes in seasons.

____C5 Observe characteristics of varying climatic zones.

a. Describe the characteristics of major climatic zones (flora, fauna, temperature patterns, rainfall patterns).

Sources

Field trip to local monitoring station

____C6 Observe and define air and water quality standards.

a. Compare polluted and non-polluted air and water.
b. Observe techniques and instrumentation for measuring air and water quality.

____C7 Observe the characteristics of oceans.

a. Observe simple marine environments (shores, tides, salinity, wave action, flora, fauna).

Sources

____A4 Observe changes in the characteristics of objects in the sky.

STEM-3
MAPS-4
STEM-4

a. Moon - shape, color, position.
b. Sun - color, brightness, position.
c. Stars - brightness, color.
d. Clouds - shape, color, position.

____A5 Observe changes in size and shape of shadows over time.

ESS (Where is the moon?)
ESS (Lights & Shadows)
ESS (Daytime Astronomy)
STEM-3

Sources

GR4 Distinguish between plants and animals.

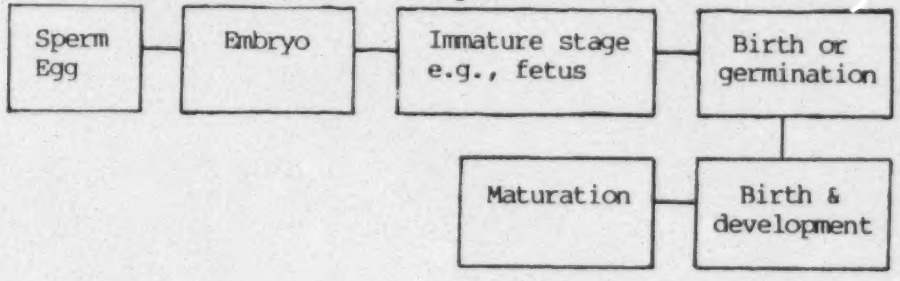
MAPS-3

a. List the characteristics of plants.
b. List the characteristics of animals.

GR5 Relate seeds and offspring to mature organisms and to the reproductive cycle.

MAPS-4

a. Distinguish between seeds according to color, size, shape, and texture.
b. Distinguish between animals according to size, shape, color, and texture.
c. Match seeds to mature plants.
d. Match animal parents to their offspring.
e. Classify the reproductive organs (penis, vagina, flower).
f. Observe the basic reproductive cycles:



Sources

ESS (Butterflies)
ESS (Eggs & Tadpoles)
MAPS-4
Sex Ed. Curriculum
ESS (Growing Seeds)

_____GR6 Observe the stages of the life cycles of organisms.

a. Measure and record plant growth.
b. Measure and record the growth of animals.
c. Observe and describe the basic life cycle of a plant (seed germination, growth and development, maturity, seed production, death).
d. Observe and describe the growth of plants from seeds, cuttings, runners, and bulbs.
e. Observe and describe the methods of seed dispersal (wind, water, animals).
f. Observe and describe the life cycles of animals (egg, sperm, baby, child, adolescent, adult, death).
g. Sequence in proper order the stages of various life cycles.

H2 Compare organisms in terms of habitats and populations, and in terms of the effects various environmental factors have on the organisms.

a. Describe and compare seasonal changes in animals (color, hair growth, sleeping habits, feeding habits, movement, death rates).
b. Observe and describe phototropism and geotropism.
c. Demonstrate that seeds need light, water, minerals, soil, and air to grow and develop.
d. Observe that plants get water and dissolved minerals from the soil.
e. Describe the seasonal changes in plants.
f. Demonstrate what animals need for a healthy existence (food, water, air, shelter).
g. Demonstrate the proper care and handling of plants and animals (food, light, water, shelter, exercise, grooming).
h. Classify plants according to habitat (water, land).
i. Classify animals according to habitat.

Sources

MAPS-3
STEM-3
ESS (Pond Water)

Sources

MAPS-2
ESS (Bones)

____S2 Classify organisms according to various schemes.

a. Classify plants according to size, leaf arrangement.
b. Classify according to plant/non-plant.
c. Classify animals according to size, etc.
d. Classify according to animal/non-animal.
e. Classify according to living/non-living.
f. Classify according to plants, animals, and non-living.
g. Classify fossils according to plant or animal.
h. Classify leaves according to shape, color, size, and texture.
i. Identify and label analogous parts of a variety of animals (eye, nose, ear, hands, feet, tail, hair, fur, feathers, skin, paws, arms, legs, elbow, knee, neck, teeth, tongue, lip, toe, finger, thumb, butt, back, navel, belly, hooves, claw, wing, fin, shell, etc.) and classify animals according to their parts.
j. Identify and label analogous parts of a variety of plants (roots, stems, leaves, flowers, fruits, etc.).
k. Investigate how different animals use the five senses (sight, hearing, touch, taste, smell).

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Sources

STEM-4
MAPS-4

HA3 Observe and classify elements of a simple food web (classify animals on the basis of diet).

a. Classify organisms to trophic level as either producers (plants), first order consumers (herbivores) or second order consumers (predators or carnivores, parasites, etc.).
b. Distinguish the elements in a simple food chain (sun, producer, consumer, decomposer).
c. Classify plant parts that are edible and non-edible (fruits, vegetables, seeds).
d. Observe the preparation of raw fruits and vegetables (producers).
e. Observe the preparation of cooked fruits and vegetables (producers).
f. Observe the preparation of meats for consumption.
g. Match a fruit or vegetable with its plant of origin.
h. Classify animals according to pet/non-pet.
i. Demonstrate the proper care and handling of animals and plants.
j. Observe meats that are eaten.

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Sources

____HA4 Identify the proper handling of environmental materials.

a. Observe symbols for poison.
b. Classify trash, litter, garbage, and the containers used.
c. Describe ways of keeping the environment clean of trash.
d. Distinguish forms of pollution (air, water, land, sound).
e. Recognize poisonous plants and animals.

Sources

Sex Ed. Curriculum

____HR3 Classify as male or female according to external characteristics.

____HR4 Classify humans according to stage of development (pre-natal, infancy, childhood, adolescence, adulthood).

____HR5 Observe the basic external physical changes that occur during the stages of human development.

Concrete: The student uses logical thought processes if perceptual (especially visual) stimuli are present. However, the child is still unable to apply logical thinking to "words only" situations.

Sources

_____PM6 Classify objects according to multiple system.

a. Classify objects according to the properties of two or more major characteristics. Include all the previously observed and classified properties.

_____PM7 Sequence collections of similar objects in serial order according to size.

_____PM8 Classify and characterize objects according to properties of states of matter.

ESS (Gases and Air)
ESS (Ice Cubes)
STEM-5

a. Describe the characteristics of each state of matter.
b. Classify substances according to the state of matter (solid, liquid, gas).

Sources

ESS (Peas & Particles)
ESS (Kitchen Physics)

_____PM9 Measure relative physical properties of matter using the metric system.

a. Measure the dimensions of objects and linear distance using metric units (meter, centimeter, millimeter).
b. Measure the mass of objects using metric units (gram, kilogram).
c. Measure and calculate the volume of liquids and solids using metric units (liter, milliliter).

_____PM10 Characterize and classify the physical and chemical properties of matter.

a. Observe and differentiate between mixtures and solutions.
b. Observe and differentiate between common metal and non-metal objects (metal ruler and wooden ruler).
c. Observe and compare examples of solutions, mixtures, elements, and compounds.
d. Compare and contrast physical and chemical changes in matter (cutting wood vs. burning wood).
e. Describe the observable generic properties of elements.
f. Describe the observable generic properties of a compound.
g. Classify matter as elements, compounds, mixtures, or solutions.

Sources

_____PM11 Classify types of changes in properties (physical, chemical) of everyday objects.

a. Classify change as either physical (dissolving in water, melting, breaking) or chemical (burning, digesting food).

Sources

ESS (Heating and Cooling)
MAPS-5
STEM-5

___E14 Classify characteristics of energy transmission of each form of energy.

a. Classify as good or poor electrical conductors and insulators.
b. Classify as good or poor heat conductors and insulators.
c. Classify the capacity of sound to travel through solids, liquids, and gases (vacuum also, if possible).

____E15 Observe energy transformation from one energy form to another.

a. Investigate the transformation of energy (heat to light, sound to mechanical, mechanical to electrical, chemical to heat, light to heat).
b. Identify the transformation of energy in objects used in everyday living.

Sources

_____E16 Using the metric system, measure quantitatively the energy present.

a. Measure the freezing and boiling temperatures of water with a thermometer.
b. Measure the chemical energy in a sugar cube using a calorimeter.
c. Measure sound in decibels using an audiometer.
d. Measure the flow of electrical current with an ammeter.
e. Measure electrical potential with a voltmeter.
f. Measure light intensity with a photoelectric cell.

____E17 Explore the characteristics of each energy form.

ESS (Whistles and Strings)
tuning forks
STEM-6

a. Investigate the effect of a prism on white light.
b. Investigate vibration and its relation to sound.
c. Investigate sound transmission in a water tank.
d. Investigate static and current electricity.

Sources

_____E18 Construct and observe energy systems and their components.

ESS (Batteries & Bulbs)
ESS (Optics)
ESS (Whistles & Strings)
ESS (Musical Instrument Recipe Book)

a. Discriminate between simple open and closed circuits.
b. Construct an electromagnet.
c. Construct a simple electrical circuit.
d. Construct systems that produce shadows.
e. Construct and investigate three simple machines (lever, wheel, inclined plane).
f. Construct simple sound systems.
g. Construct simple light systems.
h. Construct light systems using lenses and mirrors.
i. Classify objects in everyday living according to their function within an energy system.

_____E19 Predict the outcome of an arrangement of components in an energy system.

STEM-5
STEM-6

a. Predict how the placement of the light source affects the shadow produced.
b. Investigate objects that reflect light and images (metal, mirror).

Sources

____ E20 Discuss the significance of the proper use of energy forms.

a. Describe the reasons for safety procedures in laboratory activities and home practices.
b. Describe the reasons for conservation procedures in school and home practices.

Sources

STEM-5
STEM-6

____ F11 Classify force, work, and motion according to directionality and magnitude.

a. Classify forces according to relative directionality and magnitude.
b. Describe characteristics of gravity.
c. Classify force, work, and motion according to magnitude over time.

____ F12 Measure changes due to force, work, and motion (distance, weight).

a. Measure distance changes (centimeter, meter).
b. Measure force using a spring scale (comparisons to a referent).
c. Observe use of standard measurement systems (metric only).

____ F13 Analyze the characteristics of machines in everyday living.

a. Analyze pulleys and the work they perform.
b. Analyze gears and the work they perform.
c. Analyze compound machines according to the simple machines used within a system.

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Sources

STEM-5
ESS (Rocks and Charts)

____G10 Record and classify types of rocks, soils, and minerals by characteristic properties.

a. Classify some common gemstones (diamond, ruby, emerald, etc.).
b. Classify rocks and minerals according to their characteristics (granite, sandstone, conglomerate, coal, agate, etc.).
c. Identify layers of soil (topsoil, subsoil, bedrock).
d. Discuss the effects of wind, water, heat, and people on the soil.
e. Identify common rocks according to their characteristics and formation (igneous, metamorphic, sedimentary).

____G11 Identify the uses of, and means of processing, rocks and minerals.

a. Identify common uses of rocks and minerals (building, fuel).
b. Observe processes by which rocks, minerals, and other natural resources are processed (mining, etc.).

Sources

STEM-6

____ G12 Classify landforms by varieties of characteristics.

a. Classify the occurrence and effects of natural geological phenomena (foothills, continents, ranges, glacier, moraine).
b. Describe (construct) common landform models and maps (relief, topographic).

____ G13 Record and classify changes and processes affecting changes in the physical (geological) environment.

a. Identify principal causes of erosion (wind, water, people).
b. Identify the features of the ongoing erosion process on the earth.

____ G14 Analyze and classify rocks and soils, utilizing scientific schemes of organization.

a. Classify some common gemstones according to specific characteristics.
b. Classify some common rocks and minerals according to specific characteristics.
c. Classify general soil types according to specific characteristics.

Sources

____C8 Observe, record, and classify changes in weather (local/non-local, short and long range.)

EYE (Mini-Climates)
EYE (Snow and Ice)

a. Investigate ways to detect the presence of air (fan).
b. Observe the effects of wind and water on the environment (tornadoes, hurricanes).
c. Observe and record temperature, rainfall, humidity, and wind velocity.
d. Interpret the use of symbols on a weather map.
e. Record and predict weather conditions and changes.

____C9 Investigate the basic water cycle.

MAPS-4

a. Observe and discuss evaporation, cloud formation, and condensation and precipitation.
b. Investigate the characteristics of the major cloud formations.
c. Investigate the conditions for the formation of the precipitation types (dew, frost, rain, sleet, snow, hail, fog).

Sources

____C10 Investigate the characteristics of major climatic zones. STEM-5

a. Describe and compare the climatic zones.
b. Differentiate the climatic zones across seasons.

____C11 Observe, record, and classify the quality of air and water. MAPS-6

Sources

____A6 Distinguish between objects in the sky.

ESS (Where is the Moon?)
ESS (Patterns in the Sky)
ESS (Daytime Astronomy)
MAPS-5
STEM-6
EYE (Astronomy)

a. Observe some of the characteristics of the sun (hot, movement).
b. Observe some of the characteristics of planets and the moon.
c. Sequence the planets of the solar system in terms of size.
d. Classify the nine planets, sun, moon in terms of size, distance, temperature, weight, gravity, color, age, atmosphere, and probability of life present.
e. Observe and describe some of the major constellations (Ursa Major and Minor, Orion, the Zodiac, etc.).

____A7 Observe and record the motion of the sun, moon, and planets across the sky.

Planetarium

a. Record the daily movement of the sun (day, night, horizon, zenith, azimuth, altitude).
b. Record the daily movement of the stars, moon, and planets (by season).
c. Describe the annual movement of stars, moon, and planets (revolution, rotation).

Sources

____A8 Observe and record changes of shadow length over different time periods (direction and path).

a. Describe the elements necessary to produce a shadow.
b. Demonstrate how the placement of the light source affects the shadow produced.
c. Demonstrate solar and lunar eclipses (umbra, penumbra).

____A9 Observe and record characteristics of seasonal change.

a. Demonstrate the movement of the earth around the sun in terms of time (day, night, seasons, revolution, rotation, tilt).
b. Construct a model to demonstrate what is in the current sky.

Sources

MAPS-5
MAPS-6
STEM-5
ESS (Brine Shrimp)
ESS (Behavior of Mealworms)

_____GR7 Classify organisms according to their life cycles.

a. Investigate the growth of a tree (seed, seedling, sapling, mature tree, death, decomposition).
b. Investigate seasonal differences in plants (flow of sap, color, leaves, dormant states, death) and animals.
c. Classify plants according to annual, biennial, perennial.
d. Classify plants according to distinguishable aspects in their respective reproductive cycles (e.g., mosses vs. dicots).
e. Communicate the changes in the body during the growth and development processes (especially in humans).
f. Classify animals according to method of reproduction (asexual vs. sexual).
g. Classify and label animals that need parenting and those that do not.
h. Compare the reproductive cycle of humans to the reproductive cycle of animals (birds, reptiles, amphibians, mammals, etc.).

Sources

____ H3 Observe, record, and classify characteristics of populations.

ESS (Peas and Particles)
MAPS-6
EYE (Small Creatures)

a. Observe the interdependence of populations.
b. Observe the social behavior of animals (bees, ants, wolves, humans).

____ H4 Observe, record, and classify organisms in their relationships to a food web (producers, consumers, decomposers, concepts of community, terrestial, aquatic).

MAPS-5
STEM-6

a. Observe and classify as predator/prey relationship, parasitism, commensalism, etc.
b. Observe and give examples of competition within an ecosystem.
c. Classify plants as producers or consumers in the food web.
d. Observe and give examples of the process of decomposition within an ecosystem.

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Sources

____H5 Observe, record, and classify organisms according to responses to environmental factors. MAPS-5

a. Classify and compare plants according to photosynthetic/non-photosynthetic.
b. Describe the characteristics of habitats (rainfall, soil, climate, temperature).
c. Investigate characteristics of plants and animals across and within environmental settings (forest, desert, grasslands, mountain, tropic, rainforest, seashore, aquatic, marine, arctic).
d. Investigate adaptations of plants (overcrowding, seasonal change, drought, enemies, geotropism, hydrotropism, phototropism, chemotropism, thermotropism, thigmotropism).
e. Investigate adaptations in animals (overcrowding, resources, environmental niche, drought, migration, senses).

Sources

MAPS-5
STEM-6
ESS (Faithful Eye of Robert Hooke)
ESS (Budding Twigs)
ESS (Tracks)
ESS (Bones)

____S3 Classify structures of organisms according to function.

a. Investigate the functions of roots, stems (trunks), leaves, flowers, branches, bark, taproot, diffuse roots.
b. Compare and classify leaves by type (simple, compound, needle, pointed, serrated, lobed, etc.).
c. Compare and classify trees according to deciduous/coniferous.
d. Compare trees according to age.
e. Observe plant cells using a microscope and identify major cell parts (organelles).
f. Distinguish between different major types of plant cells.
g. Observe groups of similar cells in plants and animals (tissue).
h. Compare and contrast plant and animal cells.
i. List and describe the function of the organs of a plant.
j. Investigate the sexual parts of a plant (stamen, pistil, pollen, petal, sepal, anther, stigma, calyx, style, ovary, corolla, filaments, nectar).
k. Investigate how plants produce asexually (runner, cutting, leaf, bulb, rhizome, node, spore).
l. Identify parts of the body (chin, eyebrow, eyelash, ankle, wrist, waist, scales, fingernail, beak, bill).
m. Classify animals according to structure (body parts, covering, diet, locomotion).
n. Compare and contrast the five senses in animals.
o. Classify animals according to vertebrate/invertebrate.
p. Observe animal cells and identify the major cell parts (organelles).
q. Compare the structure and function of plant and animal cells.

Sources

_____S4 Explore evolving life forms on the earth.

a. Distinguish the most commonly known dinosaurs and their hypothesized diets.
b. Compare the theories which attempt to explain the beginning development of earth life forms.
c. List the characteristics of the major eras (Age of Mammals, Age of Reptiles, Age of Invertebrates, Age of Organisms, Age of Micro-Organisms, Age of Formation).

Sources

___HA5 Identify and classify commonly used plants and animals.

a. Give the names of plants and meats commonly eaten in an American diet.
b. Classify according to fruit or vegetable.
c. Match fruits and vegetables to the plants of origin.
d. Classify plants according to their edible parts (roots, fruits, leaves, or stems).
e. Classify plants as poisonous or non-poisonous.
f. Classify animals as edible or non-edible.
g. Match meats to the animals of origin.
h. Describe the uses of plants in medicine, food preparation, and clothing.
i. Give examples of commonly used wood (oak, maple, cherry, pine, birch, walnut).
j. Match the products of an animal to the source (milk, cheese, clothing, guitar strings, jello, butter, eggs, etc.).
k. Describe the use of animals in medicine, research, and diagnosis.
l. Explore plant and animal foods in the diets of other countries.

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Sources

____HA6 Identify methods of caring for people and animals.

a. Describe the care and handling of pets and plants.
b. Investigate organizations that help animals.
c. Outline why cleanliness is an important health concept in food handling.
d. Give reasons for visiting medical personnel.
e. Recognize different medicines and first aid equipment available for home and emergency use.
f. Outline treatments for common diseases (rest, liquids, diet, medication).

____HA7 Classify and demonstrate the proper handling of environmental materials. MAPS-6

a. Distinguish between forms of pollution, in terms of their effect on humans, other animals, and plants.
b. Demonstrate ways to conserve energy.
c. Describe disposal and reclamation techniques which adequately handle environmental waste materials (landfill, water filtration, plants, sewage, etc.).

Sources

____HR6 Locate and describe the function(s) of the internal and external reproductive organs of males and females (scrotum, testes, prostate, Cowper's glands, ovaries, Fallopian tubes, uterus, vulva, etc.).

Sex Ed. Curriculum

____HR7 Investigate detailed characteristics of the stages of human development (conception, embryo, fetus, etc.) through adulthood.

Transition to Formal: The student is beginning to be able to use logical propositions and hypothetical reasoning without the necessity of having concrete objects to support thought processes. The student fluctuates between the concrete and the formal levels. Because of this fluctuation, hypothesis formation should be supported by the presence of concrete instances and objects.

Sources

_____PM12 Measure and compare changes in the physical properties of matter (volume, temperature) using the metric system of measurement.

_____PM13 Develop a scientific model to explain changing states of matter.

MAPS-7
ESS (Mystery Powders)

a. Formulate hypotheses on how matter behaves in its three states.
b. Explain the behavior of solids, liquids, and gases according to the scientific model of atoms.

Sources

MAPS-8

_____PM14 Explore the periodic chart model for the classification of elements and substances (based on chemical and physical properties).

a. Match the appropriate chemical symbol with the more important elements.
b. Describe the characteristics of each family of elements.
c. Construct a two- or three-dimensional model illustrating the parts of an atom (neutron, proton, electron).
d. Construct symbolic models of elements, mixtures, and compounds.
e. Investigate and formulate hypotheses about the atomic nature of matter.

_____PM15 Plan and carry out systematic investigations of the nature of elements, mixtures, and compounds.

Sources

_____E21 Investigate combinations of simple energy systems (transmission, transformation).

ESS (Optics)
ESS (Batteries & Bulbs II)
MAPS-8

a. Construct and investigate the outcomes of two types of electrical circuits (series, parallel).
b. Construct and investigate electrical systems with multiple components (telegraph, electromagnet).
c. Investigate the characteristics of light (absorbing and heat producing; travels in a straight line; can be reflected or refracted; black is defined as the absence of light, white as the presence of all visible light).
d. Investigate the characteristics of lenses (concave, convex) and mirrors (plane, curved).
e. Investigate the nature of energy systems in terms of conduction and insulation.
f. Investigate the nature of transformation of energy within systems.
g. Investigate the principles of sound transmission through solids, liquids, and gases.

_____E22 Observe and analyze the components of simple energy systems found in everyday life.

SCIS (Energy Sources)
ESS (Batteries & Bulbs II)
MAPS-8

a. Investigate light production (flashlight, lamp).
b. Investigate voice production (pitch, intensity).
c. Investigate the production of electricity (battery, solar cell).

Sources

____E23 In simple energy systems, measure the energy present. MAPS-8

a. Measure the properties of static, AC, and DC electricity (volts, amperes, ohms).
b. Measure expansion and contraction of substances.
c. Measure freezing and boiling temperatures of various substances.
d. Measure quantity of heat in various systems.
e. Measure the intensity and amount of light (candle power, foot-candle).

____E24 Predict the quantitative effect of arrangement of components in everyday energy systems. MAPS-7

a. Investigate sources of heat (furnace, air conditioner, solar energy panels).
b. Investigate sources of electricity (solar panels, generating plant).
c. Investigate sources of sound (traffic, music, body sounds).
d. Investigate sources of light (sun, light bulbs).

Sources

____E25 Evaluate and make judgments about the proper and improper use of energy systems.

a. Formulate safety measures in the use of energy.
b. Formulate conservation measures in the use of environmental materials.

Sources

____ F14 Describe the relationship between force, work, and motion (kinetic energy).

ESS (Pendulum)
ESS (Senior Balancing)
SCIS (Whirlybirds)

____ F15 Analyze changes in systems in terms of force, work, and motion (energy). MAPS-7

a. Demonstrate the effects of friction in relation to work.
b. Use a compass to indicate directionality.
c. Investigate the rate of falling objects.
d. Investigate magnetic fields.
e. Investigate how magnetic forces are made and cancelled.
f. Outline the magnetic field of the earth.
g. Relate the concept of magnetism to the theory of molecular structure.
h. Investigate the effects of gravity.

____ F16 Analyze changes in systems of everyday objects in terms of force, work, and motion.

Sources

____G15 Develop an evolving earth concept from geological records.

MAPS-7
MAPS-8

a. Describe (construct) the characteristics of each earth layer (core, mantle, crust).
b. Describe, in sequence where appropriate, the geological formation of earth features such as geyser, continental drift, plain, butte, plateau, ocean, mountain, valley, hot spring, canyon, cave, water table.
c. Describe how scientists perform geological surveys (topographic maps, instruments, archeological digs).

____G16 Analyze the process of rock, mineral, and soil formation.

a. Identify basic characteristics of garden soils.
b. Describe the sequences of stages by which soils and minerals and other natural resources are processed.

Sources

G17 Formulate models relating processes to the geological environment.

a. Investigate and formulate hypotheses about layers of the earth and their characteristics in relation to their formation.
b. Identify and formulate hypotheses on an earth system model of major processes of change on the earth (erosion, deposition, faulting, crustal movement).
c. Demonstrate how scientists perform geological surveys.
d. Identify how people use geological information to find oil, coal, natural gas, minerals, and water.

Sources

MAPS-7
MAPS-8

_____C12 Investigate the characteristics of oceans.

a. Describe the ocean environment.
b. Investigate the characteristics of sea water.
c. Investigate the ocean tides, waves, and currents.
d. Discuss aquatic life in oceans of various climatic areas.

_____C13 Record and analyze characteristics involving changes in weather, seasonal change, and climatic areas.

a. Investigate the water cycle at the molecular level (solar energy, evaporation, condensation, cloud formation, precipitation).
b. Formulate hypotheses on the interaction of air, water, and temperature in the creation of weather conditions.
c. Record characteristics of weather systems on a weather map.
d. Investigate the principles involved in the functioning of weather instruments.

____ C14 Record, analyze, and evaluate characteristics of air and water quality.

a. Investigate the effects of air and water quality on living organisms.
b. Investigate methods/instruments used to determine air and water quality.
c. Collect and evaluate data from the local area to determine air and water quality.

Sources

Contact U.S. Environmental Protection Agency for information

____ C15 Record and analyze the characteristics of weather which are influenced by the ocean environment.

a. Investigate and evaluate the effects of air currents/ocean currents on our weather system.
b. Record the effects of ocean currents/locations on weather of particular areas (Gulf Stream, a town on an ocean).

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Sources

MAPS-8

____A10 Formulate a model of the universe.

I. The earth and its moon

a. Predict the shape and position of the moon.
b. Formulate hypotheses about the characteristics of the moon and how it affects the earth (tides, soil, eclipses, moonlight, phases, exploration).

II. The sun and its planets

a. Formulate hypotheses about the characteristics of the nine planets, sun, and moon (size, distance, temperature, atmosphere, weight in terms of gravity, color, life).
b. Construct a model demonstrating motion within the solar system.
c. Formulate hypotheses about the phenomena of the sun (sun spots, flares, eclipses, aurora borealis).
d. Investigate other celestial bodies (meteors, meteorites, comets, asteroids, cosmic dust).

Sources

A10 Formulate a model of the solar system (continued)

III. Outside the solar system

a. Identify characteristics of galaxies, nebulae, double stars, clusters, and other large groupings in the universe.
b. Compare distances in the universe in terms of light years.
c. Identify the characteristics of a star (color, size, distance, light age).
d. Formulate hypotheses about the evolving universe.

Sources

ESS (Microgardening)
MAPS-7

____GR8 Observe, record, and distinguish cycles in food webs and balanced ecosystems (water, oxygen, minerals, carbon).

a. Formulate hypotheses on the balance of nature and its relationship to the idea of "survival of the fittest."
b. Classify animals according to diet, place on the food chain, and environmental function (carnivore, herbivore, omnivore).
c. Formulate hypotheses on how populations are kept in check in nature.
d. Trace energy flow through a food web and explain the decreased availability of useful energy at each level.

____GR9 Investigate imbalanced ecosystems.

a. Investigate the effects of disruption of the food chain on an ecosystem (endangered species).
b. Investigate the effects of pollution on land, atmosphere, water, plants, and animals (including humans).
c. Investigate the effects of thermal and nuclear pollution.
d. Investigate the effects of disease on organisms.

Sources

GR10 Analyze model ecosystems.

a. Formulate models of ecosystems.

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Sources

____ S5 Observe, record, and classify organisms within existing classification schemes.*

a. Classify plants according to the four phyla (Thallophyte, Bryophyte, Pteridophyte, Spermatophyte).
b. Classify animals according to the phyla (Coelenterates-jellyfish, Platyhelminths-planaria, Annelids-worms, Echinoderms-starfish, Mollusks-clam, Arthropod-crab, Chordata-fish, Amphibians, Birds, Reptiles, Mammals).

____ S6 Observe and record indirect evidence of evolving life forms.

* NOTE: The teacher should take the classification as far as classes in several phyla.

Sources

HA8 Observe, record, and classify the human organism in relation to his/her internal and external environment.

I. Internal Environment — MAPS-7

a. Investigate the effects of outside agents on the body (drugs, medicine, tobacco).
b. Investigate the effects of bacteria and viruses on the body.
c. Communicate functions of medical personnel and techniques (including doctor's examination and research).
d. Investigate human cells, tissues, organs, and systems (digestive, skeletal, muscular, nervous, respiratory, circulatory, reproductive, endocrine) and their interrelationship.

II. External Environment — MAPS-7

a. Investigate and formulate hypotheses about the geological and biological evolution of the earth (Cenozoic, Mesozoic, Archeozoic, Azoic, glaciers, earthquakes, formation of fossil fuels), and human's place in evolution.
b. Outline negative and positive impacts of humans on their environment (ecosystems).
c. Exhibit positive attitudes toward and develop a plan for the proper management of natural systems.

Sources

Sex Ed. Curriculum
MAPS-8

____HR8 Investigate pregnancy and pre-natal stages of development.

a. Explain the signs of pregnancy and how pregnancy can be determined.
b. Describe in detail the pre-natal stages of development.
c. Explain the function of the placenta, umbilical cord, and the womb during the gestation period, and during the birth process.
d. Discuss the importance of pre-natal care to the physical and emotional health of the mother and child, and the possible damage to the fetus from chemicals, drugs, and nutritional deficiencies and/or disease.
e. Explain the term "trimester" in pregnancy and the basic characteristics of those stages.
f. Explain the steps in the birth process.
g. Explain the necessity for post-natal testing and treatment of the newborn.
h. Discuss the myths and unfounded fears surrounding childbirth.
i. Investigate the effects of heredity on offspring.
j. Describe the results of genetic diseases.
k. Explain the advances of sexual reproduction (mixing of genes).
l. Discuss the psychological and sociological factors relating to human behavior in the reproductive process and family life.

Sources

____HR9 Investigate the reproductive cycle (and its interruption) in detail.

a. Explain in detail the adolescent stage of male and female development.
b. Explain the function of the ejaculatory duct and the development of spermatozoa and semen in the male; and, in the female, the development of ova, and fertilization activity in the Fallopian tubes.
c. Discuss the implications of overpopulation on the quality of life.
d. Describe how a sperm and an egg unite to form a single cell which grows into a baby.
e. Explain the use of a diaphragm, IUD, and birth control pill and their relative effectiveness.
f. Discuss what a condom, vasectomy, and hysterectomy are, and their effectiveness in preventing pregnancy.
g. Discuss contraceptive foams, creams, and jellies; how to use them; and their relative effectiveness.
h. Discuss natural family planning (the rhythm method), what it is and its effectiveness.
i. Discuss the use of coitus interruptus as a birth control method and its effectiveness.

Sources

____ HR10 Investigate diseases associated with coitus.

a. Develop an awareness of venereal diseases' threat to one's health and to society.
b. Describe the symptoms and the procedures to follow for curing of the major venereal diseases, including details concerning gonorrhea and syphilis and their physical consequences.
c. Explain the importance of prevention and early treatment of venereal disease.
d. Describe how venereal disease is spread, including myths regarding venereal disease.

EVALUATION REPORT

for

KDES Science Program Objectives

Evaluation Report Summary

This report gives a short history of the development of the KDES Program Objectives for Science, a brief description of the contents of the document, and detailed information about the evaluation and changes made as a result of the evaluation.

The program objectives were reviewed by three persons outside Kendall Demonstration Elementary School (KDES). The reviewers generally approved the scope of the program objectives and their emphasis on process, active student involvement, and use of behavioral objectives. However, two reviewers felt the objectives often were not behavioral. One reviewer felt there was a large discrepancy between the promise of the introduction and the rest of the program objectives. The same reviewer said the actual emphasis was still on content, not process. All reviewers said that it was not clear how the teacher was expected to use the program objectives. Two reviewers felt that major revisions were necessary.

This Report lists the recommendations of the reviewers and states the action taken on each recommendation by the developers.

History of the Program Objectives

Formal development of these program objectives was begun in the summer of 1977 by a curriculum development committee at KDES. This work was continued in the following summer, with the help of a University of Maryland consultant. The program objectives were sent for evaluation to the Media Development Project for the Hearing Impaired in Lincoln, Nebraska. A further revision was made in the spring of 1980 by a consultant, a science teacher, and an instructional evaluation specialist. Finally, the program objectives were sent to three outside reviewers and revised again. This document represents the results of that final review and revision process.

Description of the Program Objectives Document

This document consists largely of objectives for an elementary school science program. It also describes the general pedagogical approach, the principles of sequencing used, and the manner in which the objectives have been organized. Procedures for student diagnosis and placement are also included.

Reviewers

Three persons served as external reviewers of the document. All three are experienced teachers of the deaf. Two have their doctorates in science education. One is currently in the Instructional Development and Evaluation Center at Gallaudet College. The second is a science teacher at the Model Secondary School for the Deaf. The third, a former MSSD science teacher, is now an administrator at MSSD.

Results of their reviews were shared with two of the developers of the program objectives and revisions were made that were deemed to be consistent with the philosophy of the KDES science program and the purposes of the document.

Purposes of this Report

This report is intended to serve the following groups or persons:

1) the developers of these program objectives as they finalize this version,

2) members of Pre-College Programs as they make dissemination decisions,

3) users of these program objectives both at KDES and in other educational settings, and

4) persons responsible for the on-going development of the science program at KDES.

Evaluation Information Collected

The form used by the reviewers is an adaptation of a form developed by the National Center for Research in Vocational Education and used by the Pre-College Editorial Board at Gallaudet. On this form, reviewers are first encouraged to make specific comments and changes directly on the document. They are then asked to summarize their comments and rate the document in the areas of scholarship, usefulness, equity, communicability, appeal, and overall quality. They then highlight what they perceive to be the major strengths of the document and give specific recommendations for improvement.

Evaluation Results

The reviewers were asked to comment on five aspects of the document: scholarship, usefulness, equity, communicability, and appeal. Their comments are summarized below.

Scholarship. One reviewer judged the scholarship as adequate for the physical sciences but rather vague for the biological sciences. Another felt that the objectives could be rewritten to show more clearly the connection among the major ideas of science. The third reviewer rated the scholarship as needing extensive revision. In particular, this reviewer said many objectives were not behavioral; certain science process skills are treated inadequately; the curriculum is structured on content, not process; placements of some objectives on a Piagetian level are dubious.

Usefulness. One reviewer stated simply that the document is useful. The second reviewer said that most of basic science is included but many of the objectives would be very difficult to achieve. This reviewer thought the purpose of the document was not clear. The third reviewer said the intended users were not clear and the use to which the document was to be put was also unclear. This reviewer also felt it was not clear why the biology content was organized differently from the physical and earth sciences.

Equity. All three reviewers found no problems here.

Communicability. The first reviewer approved except for a few points on the draft copy. The second reviewer felt the language was appropriate for science teachers but that the objectives were merely listed with no indication of a direction or "flow." The third reviewer termed the language "OK" but had numerous criticisms of other aspects: process terms like "observe" give no indication of what students are to learn; unclear where and when instruction begins; unclear what is prerequisite to what; no explanation of how this curriculum is fitted for deaf students; reference list only partially developed.

Appeal. All reviewers thought it was acceptable but not outstanding. One reviewer said the page layout could show more clearly the structure, scope, and sequence.

Recommendations of Reviewers and Actions Taken

The changes or additions recommended by the reviewers are grouped below in accordance with the priority each recommendation was given by the reviewers. After each recommendation either the action taken by the developers or the reason for not making the suggested change is stated.

Recommendations of Reviewers and Actions Taken (Continued)

Essential: "Must do"

- Change objectives into clear statements of student performance. Response: The developers wanted to keep the scientific "process" terms to the fore (observe, classify, etc.) and did not wish to abandon them for more precisely behavioral terms. Instead, a section was added that describes the kind of behavior terms.

- Write additional objectives to develop basic science process skills. Response: In the judgement of the developers there were enough objectives. However, teachers were encouraged to add sub-objectives and space was provided for them to do so.

- Correct erroneous classification of objectives at Piagetian levels. Response: This was done in most cases. In a few, the developer felt the original classification was correct.

Important: "Should do"

- Restructure the curriculum according to the sequence of science process skills and the Piagetian level of the task. Response: The objectives were resequenced into the four Piagetian levels. Within each level they were grouped by science content area. Within each content area they are arranged according to process skill.

- Expand list of resources. Response: This was done to the extent that time allowed. It was noted that the list is limited to resources available at KDES and that other users should add their own.

In addition to the above changes, the introduction was expanded and rewritten to clarify such matters as how students should be placed in the program and how the objectives were sequenced.

INSTRUCTIONS FOR NETWORKING

The recording of the child's achievements on the Network is done in the following manner:

Ø EXPOSURE TO CONCEPT

This indicates that the child has been exposed to a given concept but is not required to make specific identifications, recall information, or be evaluated in this area.

⊠ CONCEPT ATTAINMENT

This indicates that the child is able to demonstrate acquisition of the concept. Concept attainment takes into consideration:

- Concept identification: child already knows the concept class but needs to identify which concept must be applied or named.
- Concept formation: child must learn the meaning of a concept not previously known.

● CONCEPT EXPRESSION

This indicates that the child is able to convey the concept in some linguistic form. This implies that the individual is able to assimilate, organize, and categorize information and respond appropriately in some linguistic form.

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PROGRAM OBJECTIVES FOR SCIENCE
Pre-Operational Level

Student's name _____

PHYSICAL SCIENCE

Properties of Matter 1 [a][b][c][d][e][f][g][h][i][j][k][l] — 2 [a][b][c][d][e][f][g][h][i][j][k]

Energy 1 [a][b][c][d][e] — 2 [a][b][c][d][e] — 3 [a][b][c][d][e] — 4 [a][b][c][d] — 5 [a][b]

Force, Work, & Motion 1 [a][b][c] — 2 [a] — 3 [a][b][c][d][e][f][g][h] — 4 [a][b][c]

EARTH SCIENCE

Geology 1 [a] — 2 [a][b] — 3 [a] — 4

Climatology & Oceanography 1 [a] — 2 [a]

Astronomy 1 [a][b][c][d][e] — 2 [a] — 3 [a]

BIOLOGICAL SCIENCE

Growth & Reproduction 1 — 2 [a][b][c][d] — 3 [a][b][c]

Habitat 1 [a][b][c][d][e][f][g]

Structure 1 [a][b][c][d]

Human Application 1 [a][b][c][d] — 2 [a]

Human Reproduction 1 [a][b] — 2

PROGRAM OBJECTIVES FOR SCIENCE
Transition to Concrete Level

Student's name _____

PHYSICAL SCIENCE

Properties of Matter 3 [a] — 4 [a b] — 5 [a b]

Energy 6 [a b c d e f g] — 7 [a b] — 8 [a] — 9 — 10 [a b c d] — 11 [a] — 12 [a b c d e f] — 13 [a b]

Force, Work, & Motion 5 [a] — 6 [a] — 7 — 8 [a b c] — 9 [a b c d] — 10 [a b c]

EARTH SCIENCE

Geology 5 — 6 [a b] — 7 [a b] — 8 [a b c d] — 9 [a b c]

Climatology & Oceanography 3 [a b c d] — 4 — 5 [a] — 6 [a b] — 7 [a]

Astronomy 4 [a b c d] — 5

BIOLOGICAL SCIENCE

Growth & Reproduction 4 [a b] — 5 [a b c d e f] — 6 [a b c d e f g]

Habitat 2 [a b c d e f g h i]

Structure 2 [a b c d e f g h i j k]

Human Application 3 [a b c d e f g h i j] — 4 [a b c d e]

Human Reproduction 3 — 4 — 5

PROGRAM OBJECTIVES FOR SCIENCE
Concrete Level

Student's name _____

PHYSICAL SCIENCE

Properties of Matter 6 [a] —7 — 8 [a b] — 9 [a b c] —10 [a b c d e f g] —11 [a]

Energy 14 [a b c] —15 [a b] —16 [a b c d e f] —17 [a b c d] —18 [a b c d e f g h i] —19 [a b] —20 [a b]

Force, Work, & Motion 11 [a b c] —12 [a b c] —13 [a b c]

EARTH SCIENCE

Geology 10 [a b c d e] —11 [a b] —12 [a b] —13 [a b] —14 [a b c]

Climatology & Oceanography 8 [a b c d e] — 9 [a b c] —10 [a b] —11

Astronomy 6 [a b c d e] — 7 [a b c] —8 [a b c] —9 [a b]

BIOLOGICAL SCIENCE

Growth & Reproduction 7 [a b c d e f g h]

Habitat 3 [a b] — 4 [a b c d] — 5 [a b c d e]

Structure 3 [a b c d e f g h i j k l m n o p q] — 4 [a b c]

Human Application 5 [a b c d e f g h i j k l] —6 [a b c d e f] —7 [a b c]

Human Reproduction 6 —7

PROGRAM OBJECTIVES FOR SCIENCE

Transition to Formal Level

Student's name _____

PHYSICAL SCIENCE

Properties of Matter

12 — 13 [a b] —14 [a b c d e] —15

Energy

21 [a b c d e f g] —22 [a b c] —23 [a b c d e] —24 [a b c d] —25 [a b]

Force, Work, & Motion

14 — 15 [a b c d e f g h] — 16

EARTH SCIENCE

Geology

15 [a b c] — 16 [a b] —17 [a b c d]

Climatology & Oceanography

12 [a b c d] —13 [a b c d] — 14 [a b c] —15 [a b]

Astronomy

10 [I. a b] – [II. a b c d] – [III. a b c d]

BIOLOGICAL SCIENCE

Growth & Reproduction

8 [a b c d] — 9 [a b c d] —10 [a]

Habitat

Structure

5 [a b] —6

Human Application

8 [I. a b c d] – [II. a b c]

Human Reproduction

8 [a b c d e f g h i j k l] —9 [a b c d e f g h i] —10 [a b c d]

Evaluation Form
KDES Program Objectives for Science
(To be completed by non-KDES personnel)

Name of Reviewer _____ Date _____

Position _____ Organization _____

Please answer each question carefully. Information received will be used in revising the Program Objectives for future use.

1. Did the document cover all areas of the KDES Science Program about which you desired information?

   ____ yes ____ no

   If no, please specify other information desired._____

   _____

2. Was the information presented at the right level of specificity?

	Not Enough Detail	Right Amount	Too Detailed
Scope	1	2	3
Philosophy	1	2	3
Structure	1	2	3
General Instructional Principles	1	2	3
Specific Instructional Procedures	1	2	3
Evaluation Procedures	1	2	3
Description of Evaluation Forms	1	2	3
Personnel and Their Roles	1	2	3
The Science Curriculum Itself	1	2	3

   Comments: _____

   _____

3. Do you intend to use all or part of the KDES Science Program in your educational settings?

   ____ Yes ____ No

   Please comment. _____

   _____

   _____

Please complete and return this form to: Outreach, MSSD Box 114, Gallaudet College, Washington, D.C. 20002